



# Image processing in Python

## Course description sheet

### Basic information

<b>Field of study</b> Geodesy, Surveying and Cartography	<b>Didactic cycle</b> 2026/2027	
<b>Major</b> -	<b>Course code</b> DGIKN.li20.08406.26	
<b>Organisational unit</b> Faculty of Geo-Data Science, Geodesy, and Environmental Engineering	<b>Lecture languages</b> English	
<b>Study level</b> First-cycle (engineer) programme	<b>Mandatoriness</b> Elective	
<b>Form of study</b> Part-time studies	<b>Block</b> Elective Modules in Foreign Language	
<b>Profile</b> General academic	<b>Course related to scientific research</b> Yes	
<b>Course coordinator</b>	Beata Hejmanowska, Anna Malczewska	
<b>Lecturer</b>	Beata Hejmanowska, Anna Malczewska	
<b>Period</b> Semester 6	<b>Method of verification of the learning outcomes</b> Completing the classes	<b>Number of ECTS credits</b> 4
	<b>Activities and hours</b> Lectures: 9 Project classes: 18	

### Goals

C1	transfer of knowledge, skills, and social competencies in the use of the Python language for image processing
----	---

### Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
<b>Knowledge - Student knows and understands:</b>			
W1	how to apply Python for image processing in remote sensing	GIK1A_W05, GIK1A_W06, GIK1A_W07	Activity during classes, Execution of a project
<b>Skills - Student can:</b>			
U1	use interactive programming environments such as text console and Jupyter Notebook for image processing	GIK1A_U01, GIK1A_U06, GIK1A_U07, GIK1A_U08	Activity during classes, Execution of a project
U2	to use programming skills in their future professional career	GIK1A_U01, GIK1A_U06, GIK1A_U08	Activity during classes, Execution of a project
<b>Social competences - Student is ready to:</b>			
K1	to use programming skills in their future professional career	GIK1A_K01, GIK1A_K02, GIK1A_K03, GIK1A_K04	Execution of a project

## Program content ensuring the achievement of the learning outcomes prescribed to the module

The curriculum content covers working in Google Colab, including configuring and using a cloud-based Python environment, an introduction to image processing, loading and classifying satellite images, and automating tasks.

### Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	9
Project classes	18
Realization of independently performed tasks	73
<b>Student workload</b>	<b>Hours</b> 100
<b>Workload involving teacher</b>	<b>Hours</b> 27

\* hour means 45 minutes

### Program content

No.	Program content	Course's learning outcomes	Activities
1.	Introduction to Python: starting Google Colab.	W1, U1, U2, K1	Lectures, Project classes
2.	Initial image processing in Python: Visualization, histogram analysis, stretching the image contrast Sentinel. Module - matplotlib.	W1, U1, U2, K1	Project classes

No.	Program content	Course's learning outcomes	Activities
3.	Image processing in Python: Image classifications, segmentation. Averaging, edge, morphology filters.	W1, U1, U2, K1	Project classes
4.	Project preparation: Topic, image, method selection. Discussion about the project. Individual work on the project.	W1, U1, U2, K1	Project classes

## Extended information/Additional elements

### Teaching methods and techniques :

Discussion, Lectures, E-learning, Problem Based Learning, Case study

Activities	Methods of verification	Credit conditions
Lectures	Activity during classes, Execution of a project	Lectures are optional, verification of knowledge during the project presentation.
Project classes	Activity during classes, Execution of a project	Project classes are mandatory. Credit for each class is based on activity or discussion of homework assignments.

### Additional info

Lectures: Content presented at the lecture are given in the form of a multimedia presentation in conjunction with the classic blackboard lecture enriched with demonstrations relating to the presented issues. Project classes: students do the project independently, without much interference from the teacher. This is to develop a sense of responsibility for teamwork and responsibility for decisions taken.

### Conditions and the manner of completing each form of classes, including the rules of making retakes, as well as the conditions for admission to the exam

Credit of the project - on the basis of attendance at classes and a positive evaluation of the individual project report. A student may proceed to a resit twice.

### Method of determining the final grade

At the end of the course, students receive a grade for the project and a final grade. The final grade is based on individual project completion, which assesses skills acquired during the course.

### Manner and mode of making up for the backlog caused by a student justified absence from classes

Compensating for the backlog caused by absence: depending on the classes subject - self-realisation of exercises, participation in classes of another group or realisation of the exercise during the teacher's office hours.

### Rules of participation in given classes, indicating whether student presence at the lecture is obligatory

Lectures: Students participate in classes, learning the content of the course according to the course syllabus. Students are expected to ask questions and clarify any doubts. Audiovisual recording of lectures requires the instructor's consent. Project classes: Students complete practical work aimed at acquiring competencies required by the syllabus. The project's execution and final outcome are assessed.

## Literature

### Obligatory

1. Python - Official Site - <https://www.python.org>

### Optional

1. [https://www.esa.int/Applications/Observing\\_the\\_Earth/Copernicus/The\\_Sentinel\\_missions](https://www.esa.int/Applications/Observing_the_Earth/Copernicus/The_Sentinel_missions)

## Scientific research and publications

### Research

1. [https://home.agh.edu.pl/~galia/research\\_bh\\_en.html](https://home.agh.edu.pl/~galia/research_bh_en.html)

### Publications

1. Challenges in preparing datasets for super-resolution on the example of Sentinel-2 and Planet Scope images / A. MALCZEWSKA, J. Malczewski, B. HEJMANOWSKA // The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences ; ISSN 1682-1750. — 2023 — vol. 48-1/W3-2023, s. 91-98. — Bibliogr. s. 97-98, Abstr. — Publikacja dostępna online od: 2023-10-19. — 2nd GEOBENCH Workshop on Evaluation and BENCHMARKing of sensors, systems and GEOspatial data in photogrammetry and remote sensing : 23-24 October 2023, Krakow, Poland
2. Assessing land cover changes using the LUCAS database and sentinel imagery: a comparative analysis of accuracy metrics / Beata HEJMANOWSKA, Piotr KRAMARCZYK // Applied Sciences (Basel) [Dokument elektroniczny]. — Czasopismo elektroniczne ; ISSN 2076-3417. — 2025 — vol. 15 iss. 1 art. no. 240, s. 1-20. — Wymagania systemowe: Adobe Reader. — Bibliogr. s. 18-20, Abstr. — Publikacja dostępna online od: 2024-12-30

## Learning outcomes prescribed to a field of study

Code	Content
GIK1A_K01	krytycznej oceny posiadanej wiedzy i stałego samokształcenia i samorozwoju zawodowego
GIK1A_K02	odpowiedzialnego i zgodnego z etyką wykonywania zawodu
GIK1A_K03	wypełniania zobowiązań społecznych i działalności na rzecz społeczeństwa i interesu publicznego
GIK1A_K04	myślenia kategoriami przedsiębiorczości i marketingu
GIK1A_U01	pozyskiwać, integrować i interpretować informacje z literatury polskiej i obcej, samokształcić się, wyciągać wnioski oraz formułować i uzasadniać opinie z pozyskanych informacji, szczególnie w zakresie geodezji i kartografii i dziedzin pokrewnych
GIK1A_U06	zaprojektować, wykonać i zinterpretować obserwacje geodezyjne, fotogrametryczne i teledetekcyjne związane z pozyskiwaniem danych przestrzennych, używając właściwych metod, technik i narzędzi, a także wykorzystać technologie komputerowe i narzędzia informatyczne do analizy, przetwarzania, wizualizacji i udostępniania danych i informacji przestrzennych
GIK1A_U07	zastosować analizę statystyczną i odpowiednie algorytmy do oceny wyników obserwacji, rozwiązywania zadań geodezyjnych i prognoz badanych zjawisk przestrzennych
GIK1A_U08	zapisywać obiekty świata rzeczywistego w systemie informacji przestrzennej oraz tworzyć i realizować procedury postępowania w języku formalnym za pomocą prostych narzędzi programowych
GIK1A_W05	podstawy technologii informacyjnych, programowania komputerowego i baz danych
GIK1A_W06	podstawy statystycznych i probabilistycznych metod analizy wyników obserwacji
GIK1A_W07	zasady, metody i techniki modelowania i wizualizacji map tematycznych i ogólnogeograficznych, obiektów i zjawisk przestrzennych, wykorzystując elementy grafiki inżynierskiej, metody kartograficzne oraz narzędzia informatyczne